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ABSTRACT

This study compares self-instructional mastery and nonmastery treatments of a specially developed geography unit to determine if there were differences in learning, retention, and time-to-testing of high, middle, and low aptitude students. Mastery learning is an alternative which gives lower performing students the necessary additional time to learn while the progress of the higher aptitude student is retarded by withholding of additional learning tasks. Twenty grade 7 classes from Savannah-Chatham County School District, Georgia, were chosen as the experimental population. Mastery and nonmastery units were randomly assigned to classes in each school. Tests were administered to measure the students' learning and retention of the content materials. The results indicated that high and middle aptitude self-instructional mastery treatment students retained more than high and middle aptitude nonmastery students. Middle aptitude mastery students learned more than middle aptitude nonmastery students. There was no difference between learning and retention for low aptitude students across treatments. Therefore, the differences between aptitude levels were increased rather than diminished when self-instructional mastery units were used. The educational implications were that mastery treatment facilitated superior achievement at the price of less work covered in the time period, and that mastery treatment for low aptitude students could be effective only with close and careful teacher feedback instead of self-instruction. (DE)

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MASTERY LEARNING AND GEOGRAPHY; EFFECTS UPON ACHIEVEMENT, RETENTION, AND TIME-TO-COMPLETION

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Mastery learning has been proposed as a teaching-learning procedure that may substantially increase the proportion of students enjoying successful and rewarding school learning experiences. Mastery learning is a term coined by Bloom (1968) who contends that "....all or almost all students can master what they are taught." In contrast to programmed instruction designed for individual self-instruction, feedback, and re-learning, Bloom's mastery learning envisions the use of procedures "whereby each student's instruction and learning can be managed within the context of ordinary group-based classroom instruction, as to promote his fullest development."

Bloom not only proposes mastery learning as an alternative which will give lower performing students the necessary additional time to learn, but he even alleges that mastery procedures will minimize differences in achievement resulting from differences in aptitude. He claims that as many as ninety-five per cent of the school population can learn most of the material to a stipulated criterion level provided they are given sufficient time and adequate correction and feedback. Mastery procedures will not be effective for five per cent of the population because of innate learning disabilities (Bloom, 1968).

The Bloom hypothesis that mastery learning procedures can overcome aptitude differences is contrary to the mass of psychological evidence which indicates that most treatments are insufficient to overcome differences in aptitude (DeCecco, 1968) and that methods of teaching share the common result of ineffectiveness (Wallen and Travers, 1963).

Furthermore, Bloom mastery procedures are class-paced rather than individual-paced mastery. In the Bloom procedure, the progress of the higher aptitude student is retarded by the withholding of additional learning tasks. Instead, he serves as a tutor or teacher aide to assist the lower performing and slower student. In contrast, in individual-paced instruction, whether of the earlier Winnetka type

(Washburne, 1922) or the more recent IPI-type (Glaser, 1968), the higher aptitude student has consistently achieved at a higher performance level and completed more units of study.

In a class-paced mastery procedure, as proposed by Bloom, low achieving students attain the criterion level attained by high achieving students. But the increase in achievement by low aptitude students is attained at the cost of two trade-offs which may not be educationally desirable. One is the slow down in the achievement pace of the high aptitude student. This use of high aptitude talent to assist low achievers might, in the long run, constitute a waste of educational talent. The short-term run of most mastery studies thus far, however, neither provide the evidence for the abuse of high aptitude student talent nor the long-term efficacy of mastery procedures for low aptitude students.

The second trade off is in the amount of time required to attain the criterion level established for "mastery." The provision of extra learning time for the low aptitude student may provide a substantial learning difference.

One of the alleged advantages of mastery is that while the procedure may be initially slower, the thorough learning of content and procedures facilitates subsequent learning. This claim may hold some merit for hierarchically organized subjects, such as mathematics or foreign languages, but may not be true for subjects, such as the social sciences, in which the complexity of the subject matter appears to be primarily a function of factual, conceptual, and syntactical complexity rather than the sequencing of learning hierarchies.

The social studies contain learning clusters based on the concepts and facts being presented, but their sequencing, however logical, appears to be arbitrary. Mastery procedures may

facilitate subsequent learning in elementary arithmetic but mastery procedures may not transfer to elementary history, because new factual and conceptual material is largely discrete.

Thus in the social studies it might be possible to attain mastery over a portion of the material to be covered, but this intensive coverage is attained at the expense of a more extensive treatment. Time to teach and learn in a school setting is limited. Consequently, it is not educationally desirable to ignore the amount of time required to achieve a given task. In the Carroll model of school learning (Carroll, 1963), aptitude is a function of the time taken to learn. Consequently, any investigation of mastery learning must take into account the time students take to achieve mastery. Time is thus not only a contextual variable, but it may also be regarded as an important treatment variable.

Research in mastery learning to this date has not systematically examined the various variables implicit in any learning system. Rice (1973) identified seven independent variables and four dependent variables which require systematic examination to establish a body of evidence to substantiate the allegations of mastery learning. Generally, mastery learning has been presented as a panacea (Block, 1971) with an overgeneralization and statement of claims. In a critical analysis of the state of the art and quality of research, Mitchell (1974, in draft) concluded that much mastery learning research is based on crude comparisons of a mastery group with a non-mastery group, often with ex post facto comparisons. Thus, while mastery learning procedures have generally been reported as superior to non-mastery procedures (Kim, 1969, 1970; Block, 1970; Lee, 1971), it is extremely difficult to assess the results of such research. The reader is left with the feeling that many comparisons of mastery with non-mastery procedures

are merely comparisons of superior with inferior instruction, or may result from the halo effect of experimental treatment.

In selecting a focal point for this study in mastery learning, it was decided to design a study which would give importance to the aptitude variable in mastery learning. This question appeared to be crucial, for there appears to be a tendency to make claims for mastery learning and aptitudinal variation which are not substantiated by the evidence.

General Statement of the Problem

The central question this study addresses itself to is this: If a mastery procedure is used in teaching a geography unit at the grade seven level, will the average achievement of students at three levels of aptitude be significantly different?

Research Hypotheses

The major purpose of this study was to compare self-instructional mastery and non-mastery treatments to determine if there were differences in learning, retention and time-to-testing of high, middle and low aptitude students.

The following research hypotheses were investigated.

1. The mastery and non-mastery treatments will produce differences in the average affects which are not the same ($p<.05$) at the high, middle, and low aptitude levels measured by posttests of:

(a) learning

(b) retention

and a measure of,

(c) times-to-testing

2. With pupils pooled across the three levels of aptitude the difference between the mastery and the non-mastery treatments will pro-

duce differences ($p<.05$) in the average achievement measured by geography posttests of:

(a) learning

(b) retention

and a measure of,

(c) times-to-testing

3. With pupils pooled across the two treatments, there are differences among the three levels-of-aptitude vectors of average effects ($p<.05$) measured by geography posttests of

(a) learning

(b) retention

and a measure of

(c) times-to-testing

Procedures

A geography unit titled Functions of Cities(Jones,1974) was developed by the researcher. The self-instructional unit consisted of a student text and two forms of the student workbook. Two treatments were devised. The non-mastery treatment (T_2) received the student text and a workbook. The workbook contained prescribed activities and a single review test for each chapter. Students worked through both. The mastery treatment (T_1) received the same student text but the workbook varied. Each chapter of the workbook contained two review tests. If the criterion level was not attained in the first review test, mastery students were required to correct and relearn material and then take a second review test.

Two basic concepts of urban geography used in relations to cities,

function and economic base, were identified as the major themes of these project materials. The two major concepts along with related generalizations and facts were recorded in a table of specifications which was used in the construction of the measuring instruments.

A 40 item multiple choice test and a 24 item recall test was developed by the researcher to collect data to measure students' performance for the experiment. Both tests were used to measure learning and retention of the content materials. The retention measure was administered 17 days after the conclusion of instruction.

Twenty grade seven classes from the Savannah-Chatham County School District Georgia, waived as the experimental population. Treatments were randomly assigned to classes in each school. All subjects were administered the word meaning section of the Iowa Tests of Basic Skills: Form 5 and 6 (Lindquist and Hieronymus, 1971). Students within the 20 classes were then placed in three levels of aptitude. Classes were then randomly assigned to two groups and treatment was randomly assigned to groups.

Because individual classes were the smallest units of independence, class should have been the smallest unit of analysis. However, because this study focused upon aptitude groups within class, the aptitude group mean was used as the analysis unit. The mean was obtained from the unequal Ns for each of the sixty cells. A 3 x 10 x 2,aptitude by classes-nested-within-treatments, by treatments, multivariate analysis of variance was used to compare the differential effects of two treatments across three levels of aptitude.

Results

The findings of the investigation were reported separately for each of the statistical hypotheses used to test the research hypotheses. The research hypotheses were intended to establish whether self-instructional, mastery procedures reduced differences in achievement of high, middle, and low aptitude students, as measured by tests of learning, retention, and times-to-testing. (See Table 1 and 2 for summary of statistical outcomes).

This study found that differences in aptitude were not reduced when self-instructional materials were used. The findings are reported, more specifically, for interaction of treatment and aptitude, in terms of the main effects (treatment and aptitude), and simple effects of aptitude levels across treatments for learning, retention, and times-to-testing.

Findings of the Treatment by Aptitude Interaction

No significant interactions between treatment and aptitude levels were found on the learning, retention, and times-to-testing measures. Treatment and aptitude were not acting together in this study.

Findings Between Treatment Groups

Students of high aptitude scored significantly higher than middle and low aptitude students as did students of middle aptitude over students of low aptitude on learning and retention. However, there were no differences on the times-to-testing between any of the aptitude levels.

Findings of the Aptitude Levels Across Treatment: Simple Effects

High and middle aptitude mastery treatment students retained more than high and middle aptitude non-mastery treatment students and

middle aptitude mastery students learned more than middle aptit de non-mastery students. There was no difference between learning and retention for the low aptitude students across treatments. However, high, middle, and low aptitude non-mastery students used less time than high, middle, and low aptitude mastery treatment students.

Discussion of the Results

This study found that differences between aptitude levels were increased rather than diminished when self-instructional materials were used. High aptitude students learned and retained more of the geography unit than middle or low aptitude students, while middle aptitude stu-

dents learned and retained more of the geography unit than low aptitude students. These results suggest that achievement was a function of the capacities and talents for learning that students of varying aptitude brought to the instruction.

The analysis of simple effects of treatments across each level of aptitude found that the mastery treatment facilitated greater retention for the high and middle aptitude students, and greater learning for the middle aptitude students. This was accomplished due to the feedback correction procedures required of the mastery students and the increased time that these procedures required of the mastery students for relearning. This result is consistent with that of Fishburne (1971) who used a programmed and non-programmed text. He found that exposure to the programmed text increased learning and retention but took more time across levels of reading. He attributed increased student learning to the extra time taken with the materials. Therefore, it would appear that self-instructional materials at least facilitate retention for students of high and middle aptitude students. However, the mastery procedures did not facilitate learning and retention for low aptitude students.

Low aptitude mastery students neither learned nor retained the geography material more than low aptitude non-mastery students. The low aptitude students used in this study obtained very low reading scores as measured by the Iowa Tests of Basic Skills. When converted to grade equivalent scores the low aptitude mastery and non-mastery students were reading at approximately fourth grade level. This is almost four grade levels below actual classroom level and at least two

two grades below the Grade 6 reading level of the materials Functions of Cities used in the study. Therefore, the lack of differences between the low aptitude mastery and non-mastery students can be explained by the lack of verbal facility that low aptitude students brought to instruction. The low aptitude mastery and non-mastery students consistently scored lower than the middle and high aptitude groups on the 40 item multiple choice test and often did not start the 24 item recall test. This strongly suggests that the strength of learning by low aptitude students was indeed low. Another factor that reinforces this position is that there was only a one chapter difference between high and low aptitude students at the completion of instruction. This suggests that low aptitude students did not spend the necessary time in relearning the material necessary to improve their learning. The difficulty of the material due to their inherent reading and vocabulary deficiencies probably caused frustration in learning and reduced their task orientation. Therefore, the materials Functions of Cities were probably too difficult for low aptitude students.

The review of the nine studies comparing mastery to non-mastery strategies revealed that two were below the college level, three used self-instructional materials, and none used social science materials. Within this context, all studies reported that mastery facilitated learning more than a non-mastery treatment. The emphasis of research was at the

university or college level where students used could not be considered a representative sample of normal classroom conditions.

The results of the present study indicate that when self-instructional mastery procedures are used they do not facilitate greater post-test average performance than non-mastery procedures. The findings are contrary to Moore, Mahan and Ritts (1968), Green (1969), and Gentile (1970). These researchers used self-paced procedures. However, they used content that is sequential by nature (math and science content) and each learning task was contiguous with the next. This study used geography materials organized in a specific sequence devised by the researcher. However, the materials were constructed and organized around two major generalizations and this scheme was followed through each of the chapters. The results of the present study apply to the materials and students in this study but it is reasonable to suppose that similar results would be obtained if the same materials were used with students who contained similar contextual characteristics.

The literature concerning retention (Block, 1970; Kersh, 1970; Romberg, Shepler, and King, 1970; and Wentling, 1970) found that retention is facilitated when group-paced instruction is used with correction and feedback. This study found that when self-instructional geography materials were used mastery procedures facilitated greater retention than non-mastery procedures as measured by the delayed post-test. Therefore, this would suggest that the correction-feedback procedures, either group-paced or self-instruction facilitated greater retention of original learning.

The literature review showed that only two studies reported the

time variable (Merrill, Barton, and Wood, 1970; Block, 1970). Both studies indicated that learning became increasingly efficient over a series of sequenced learning units in class-paced instruction. This study did not support these findings. Mastery students used considerably more time to learn the material than non-mastery students. These time differentials also increased when comparisons were made between aptitude levels. Therefore, the results of this study would suggest that self-paced mastery instruction requires more time than self-paced non-mastery instruction or class-paced instruction.

Discussion of Educational Implications

The basic concerns of the researcher in this study were the effects that a self-instructional mastery procedure had on students of varying aptitude when social science materials were used. Since the study found that the mastery procedure did not facilitate learning and retention for low aptitude students the following suggestions would seem in order.

The disadvantaged learner brings to the classroom many learning problems. It should be the teacher's and the school's responsibility to assist these students. Mastery procedures would appear to offer the disadvantaged student some hope of overcoming some of their environmental and hereditary learning deficiencies if a teacher is prepared to work closely with the student and to carefully monitor the mastery procedure at each level. The lack of teacher monitoring in administering the learning materials and review tests may have contributed to the poor performance of the low aptitude students. The second review test for the mastery students can

be a strong relearning tool if used correctly. The researcher did not request that the teachers monitor the retaking of the review test. The researcher believes that this led to only cursory examination of the learning material by all students and particularly low aptitude students. This is a weakness in the procedures used in this study and the researcher strongly recommends that this be controlled for in subsequent studies of a similar design and nature to this one. While the results of this study do not support the use of self-instructional mastery materials with the low aptitude student, class-paced mastery materials may operate more successfully with the slow learner.

The lack of success by low aptitude students was also a function of the degree to which low aptitude students were task oriented. Typically, low aptitude students require close personal supervision by the teacher, frequent feedback, and learning success. Stuempfig and Maehr (1970) found in a study concerning matching of materials and student characteristics, that low performing students performed better with personal rather than impersonal feedback. The low aptitude students, in this study, used self-instructional materials where all students responded independently to the learning exercises. As the low aptitude students performance, as measured by the geography achievement test, did not differ from chance to any great degree, this strongly suggests that self-instructional materials do not operate as well with low aptitude students as they operated with middle and high aptitude students.

The purpose of including the time measure in the study was to determine whether the use of correction feedback procedures which required more time facilitated learning across levels of aptitude. As

the correction-feedback procedures required that more time be spent by the mastery students it was expected that mastery students should have increased achievement. However, there were two disadvantages to this practice. First, the mastery students did not complete as much of the unit as non-mastery students. Therefore, the advantage of superior achievement must be weighed against the disadvantage of less work covered. The school must decide where its priority lies in this regard. Second, the learning of social science materials and other disciplines compete for a students learning time each day of his school life. In a society where success is most often measured by quantity rather than quality, schools may not be able to afford the extra time that a mastery procedure appears to require. The economics of achievement as weighed against extra time to attain quality of learning may not be compatible in today's schools.

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Summary of **Multivariate and Univariate** Tests
of Significance: Interaction and Main Effects

Statistical Hypotheses (Null)	F	Level of Significance
There are no differences:		
I. Between vectors (MANOVA) of learning, retention, and times-to-testing;		
1. Interaction: treatment by aptitude	1.02	N.S.
2. Main Effects: treatment	14.82	.001
3. Main Effects: aptitude	14.99	.001
II. Learning (ANOVA): mean differences for interaction and main effects;		
4. Interaction: treatment by aptitude	2.37	N.S.
5. Main Effects: treatment	2.99	N.S.
6. Main Effects: aptitude	56.39	N.S.
III. Retention (ANOVA): mean difference for interaction and main effects;		
7. Interaction: treatment by aptitude	2.07	N.S.
8. Main Effects: treatment	16.28	.05
9. Main Effects: aptitude	66.74	.05
IV. Times-to-Testing (ANOVA): mean differences for interaction and main effects;		
10. Interaction: treatment by Aptitude	0.34	N.S.
11. Main Effects: treatment	26.60	.05
12. Main Effects: aptitude	0.19	N.S.

TABLE 1.

Summary of Tests of Significance for Simple Effects:
Comparisons of Aptitude Levels Across Treatments

Statistical (Null) Hypotheses	Mean Score Mastery Treatment	Mean Score Non-Mastery Treatment	Mean Difference	Level of Signif-cance
There are no differences:				
I. Learning: treatment means across aptitude levels.				
(13) High	38.28	34.40	3.87	N.S.
(14) Middle	30.26	23.83	6.43	.05
(15) Low	15.22	17.56	-2.34	N.S.
(Simple Effects of II Table 5.17)				
II. Retention: treatment means across aptitude levels.				
(16) High	40.82	33.25	7.56	.05
(17) Middle	29.67	20.82	8.85	.05
(18) Low	16.67	14.86	1.81	.05
(Simple Effects of III Table 5.17)				
III. Times-to-Testing: treat-ment means across aptitude levels.				
(19) High	537.20*	477.67*	59.53*	.05
(20) Middle	556.46*	477.55*	78.91*	.05
(21) Low	561.33*	472.96*	88.38*	.05
(Simple Effects of IV Table 5.17)				

*Expressed in minutes

TABLE 2